REMARKS

Claims 1-10 are currently pending in the application. In an Office Action dated June 7, 2004 ("Office Action"), the Examiner rejected Claims 1-2, 4, 6-7, and 9 under 35 USC. § 103(a) as obvious over Tulloch, "Administering Internet Information Server 4," New York, McGraw-Hill Professional, 1998, ISBN: 0072128232 ("Tulloch"), rejected Claims 3, 5, 8, and 10 under 35 U.S.C. § 103 (a) as being unpatentable over Tulloch in view of "Microsoft Windows NT Server, Resource Guide," Microsoft Press, 1996, ISBN: 1,57231,344,7 ("NT Server"), and rejected Claims 1-4 and 6-9 under 35 USC § 103(a) as being unpatentable over Sicola et al., U.S. Patent No. 6,356,979 ("Sicola") in view of Schultz, "Windows NT/2000 Network Security," First Edition, ISBN: 1,57870,253,4, August 2000 ("Schultz"). Applicants' representative respectfully traverses 35 USC § 103(a) rejections, for reasons provided below.

The current application is directed towards a method for securing control-device-logical-unit ("CDLUN") operations within a disk-array controller, or in other mass-storage-device controllers, invoked by remote host computers. As explained in the current application in the two paragraphs beginning on line 27 of page 4, a CDLUN is essentially a type of virtual LUN provided by a mass-storage controller to allow remote, host computers to invoke controller functionality involving multiple LUNs. The CDLUN was developed to address a problem with disk array implementations current at the time the current application was filed – namely that there was no good, logical vehicle within the mass-storage device interface to which requests for multi-LUN operations could be addressed. As explained in the current application, a LUN represents some portion of the storage capabilities of a mass-storage-device, and a disk-array controller, or other mass-storage-device controller, provides LUNs as interfaces to the various portions, or partitions, of mass-storage space within a mass-storage device. However, certain operations, such as LUN mirroring, involve multiple LUNs. The CDLUN was devised as a target for addressing requests by remote host computers to a mass-storage-device controller for multi-LUN, or multi-partition, operations, such as a request to mirror one LUN to a different LUN. The current application makes this quite clear in the following

sentence beginning on line 16 of page 5: "CD LUNs are essentially points of access to various operations provided by, and carried out by, a disk-array controller."

Although CDLUNs serve admirably in the capacity intended, an additional problem was subsequently discovered. In general, access to individual LUNs, and to operations carried out with respect to individual LUNs, is controlled by various security mechanisms. For example, a remote host computer storing sensitive data on a particular LUN of a disk array generally arranges for the LUN storing sensitive data to be at least write-protected, and often both read-protected and write-protected, so that only the remote host computer, and no other remote host computer, can access the sensitive data. These security mechanisms are easily extended to CDLUNs. Thus, for example, only authorized remote host computers can request mirroring operations through a particular CDLUN. However, these security mechanisms proved to be inadequate to prevent unauthorized access to individual LUNs as a result of multi-LUN operations requested through CDLUNs. For example, although remote host computer A may have neither read nor write access to LUN X, remote host computer A may still alter the contents of X by, for example, requesting that LUN Y be mirrored to LUN X by sending a multi-LUN request to a CDLUN to which remote host computer A is authorized to send multi-LUN requests. As carefully explained in the current application, the method of Claim 1 is directed to closing this potential security and access problem.

Claim 1 is provided below, for the Examiner's convenience:

> 1. (original) A method for authorizing access by remote entities to logical units provided by a mass storage device comprising:
>
> providing an access table that includes entries that each represents authorization of a particular remote entity to access a particular logical unit;
>
> providing a supplemental access table that includes entries that each represents authorization of a particular control device logical unit to access a particular logical unit; and
>
> when a remote entity requests execution of an operation directed to a specified control device logical unit and involving one or more additional specified logical units, authorizing the request for execution of the operation only when an entry currently exists in the access table that represents authorization of the remote entity to access the specified control device logical unit and, for each of the one or more additional specified logical units, an entry exists in the supplemental access table that represents authorization of

the specified control device logical unit to access the additional specified logical unit.

In the first providing step of Claim 1, an access table is provided to contain and represent authorizations of particular remote entities to access particular logical units. This represents a standard approach to access control in mass-storage devices, such as disk arrays. In the next providing step, a supplemental access table is provided for containing, or representing, authorizations of particular CDLUNs to access LUNS. In a sense, this supplemental access table controls internal access of the disk-array controller, or other mass-storage-device controller, to logical units provided by the mass-storage-device controller. The supplemental access table involves controlling internal accesses by a disk-array controller to disk-array resources on behalf of requesting remote computers. Next, in the authorizing step, when a remote entity requests a multi-LUN operation through a CDLUN, authorization for the requested operation is granted only when access to the CDLUN is authorized through the access table, and access to the LUNs involved in the multi-LUN request is authorized thorough the supplemental access table for the CDLUN to which the remote entity addressed the multi-LUN request. Therefore, unlike requests directed to LUNs, a request directed to a CDLUN involves a two-step authorization process, involving authorization of access to the CDLUN via the access table and authorization of access to the multiple LUNs involved in a multi-LUN operation by the CDLUN via the supplemental access table. Claim 6 is a system claim that clearly claims components that carry out, or implement, steps of method claim 1.

LUNs and disk arrays are described and characterized in the Background of the Invention section of the current application. A distributed-file-system interface provided by a computer operating system to facilitate high-level data exchange between client and server computers is not equivalent to a LUN-based interface provided by a mass-storage-device controller to facilitate low-level data exchange operations between remote host computers and a mass-storage device, such as a disk array. Logical units, referred to as LUNs, are not equivalent to files and folders on a server computer, and a file volume on a server computer is not at all equivalent to a mass-storage device, such as a disk array. As one example, an operating system may implement a file system by storing data for a number of files on

a particular LUN provided by a mass-storage device. An operating system may choose, instead, to store an entire volume, or multiple volumes, comprising hundreds, thousands, or millions of files on a single LUN. An operating system may also choose to distribute data for a single file or volume across multiple LUNs, and even across multiple LUNs distributed across multiple disk arrays. There is no direct mapping or analogy between LUNs and mass storage devices and the files and volumes of a file system. A disk-array controller within a disk array is not an operating system running on a general-purpose, server computer. Distributed file-system protocols for data exchange are not the same as protocols used for low-level I/O operations carried out by a disk-array controller on behalf of a remote host computer. The current application is directed to mass-storage devices, such as disk arrays, mass-storage-device controllers, such as disk-array controllers, and LUN-based interfaces. It is not directed to distributed file systems.

Applicants' representative has carefully read the portions of Tulloch provided by, and cited by, the Examiner. In Applicants' representative's opinion, Tulloch is not related in any way to the method and system claim in Claims 1 and 6. Tulloch appears to concern techniques for using the NTFS file system, under the Windows NT operating system, to control access by clients to websites, virtual directories, and files within a server computer. Tulloch does not once address mass-storage device, including disk arrays, disk-array controllers, logical units ("LUNs"), CDLUNs, or just about anything else mentioned in Claims 1 and 6.

In particular, Applicants' representative has carefully noted that the supplemental access table in Claim 1 of the current application provides internal authorization for access by a CDLUN in a mass-storage device to LUNs provided by that mass-storage-device's controller. By contrast, Tulloch appears to mention only methods by which system administrators can control access by clients to various files and websites stored on a server computer. There is no mention in Tulloch of controlling access by CDLUNs on the server computer to LUNs provided by the server computer, or controlling access to any other construct on the server computer to which multi-resource-operation requests can be addressed to access other resources on the server computer. Thus, even were the Examiner's analogy between distributed file systems and LUN-based disk-array interfaces to be pressed, there is nothing in the distributed file system discussed in Tulloch equivalent to a CDLUN. In the analogy,

the distributed file system would need to provide a special type of file on a server computer that a client computer could address multi-file-operation requests to. There is no such entity in a distributed file system. Files are files – not virtual server proxies.

The Examiner appears to equate access control lists of a file-system volume with the access table claimed in Claims 1 and 6. Access control lists are not access tables. The access table clearly claimed in claims 1 and 6, and clearly described in the current application, contains and represents authorizations for remote entities to access LUNs provided by a disk-array controller, representing partitions of the storage space within a disk array.

In rejecting Claims 3, 5, 8, and 10 in Section 9 of the Office Action, the Examiner relies on the Windows NT reference. The Windows NT reference states, on page 155, that:

> Some vendors sell disk subsystems that implement RAID technology completely within the hardware. Some of these hardware implementations support hot swapping of disks, which enables you to replace a failed disk while the computer is still running Windows NT Server. RAID arrays are not described in this book. (emphasis added)

The current application concerns disk arrays and other mass-storage devices, such as RAID arrays, but the reference explicitly states are not discussed in the reference. Therefore, in Applicants' representative's opinion, the Windows NT reference adds nothing, alone or in combination with Tulloch, relevant to the current application.

In Section 10 of the Office Action, the Examiner states that:

> Although Tulloch does not explicitly teach the method wherein the mass storage device includes ports through which requests from remote entities are received, wherein the access table includes entries each comprising:
>
> an indication of a logical unit or control device logical unit;
>
> an indication of a port; and
>
> and indication of a remote entity.
>
> However, Tulloch teaches tables with customized access for logical unit and remote entities (*Tulloch pg. 152*) shows that in order to communication between a client and a server being formed the client and the server must have ports open (*pg. 303 § 5*). Therefore, it would have been obvious to one

> of ordinary skill in art at the time of applicant's invention to include ports within the table in order to provide even more secure environment to prevent logical unit attacks by remote entities.

Applicants' representative can see no justification for the Examiner's conclusion. Again, in Applicants' representative's opinion, there is no justification for an analogy between a standard client/server computer data exchange through file systems to interaction between the remote host computers and mass-storage-device controllers through a LUN interface. However, even if the analogy were to be pressed, there is no reason to assume that a client computer's operating system would employ an access table with entries including port numbers, or any other specific information. Tulloch does not teach this. Tulloch teaches nothing regarding logical units and, even if the Examiner persisted in analogizing file-system files to logical units, Tulloch discloses no special files that can undertake multi-file operations on behalf of an accessing client, as can CDLUNs within a disk array. There is no hint or suggestion in Tulloch for including the information explicitly claimed as being included in access tables within mass-storage devices in the current application in Tulloch.

Next, in sections 13-19 of the Office Action, the Examiner rejects Claims 1-4 and 6-9 over Sicola in view of Schultz. Sicola discloses control of access by a disk-array controller to LUNs within the disk-array controller by remote host computing systems. As clearly stated in Sicola in the abstract:

> The configuration table contains an entry for each logical unit which the array controller accesses to determine if a particular logical unit should communicate with a particular one of the host computing systems, an entry for each logical unit which the array controller accesses to determine if a particular logical unit should communicate with a particular one of the host computing systems using an internal offset for a logical unit number, and an entry for each logical unit which the array controller accesses to determine if a particular logical unit should communicate with a particular one of the host computing systems using a predetermined host mode.

In other words, Sicola discloses an access-table implementation similar to that described in the Background of the Invention section of the current application. Sicola's configuration table simply controls access by remote host computers to individual LUNs within a disk array, as clearly stated in the abstract. In a section of

Sicola particularly cited by the Examiner as disclosing a supplemental table, Sicola states:

> Figs. 2 and 4B-11B show examples of the data used in a configuration table in accordance with the present invention. The configuration table includes an entry identifying each logical unit (i.e., D0, D1, D2, D3, etc.), and for each logical unit, a plurality of data fields related to that logical unit, such as which host adapters in LUN should grant access to and communicate with, any offset for the LUN number to be used for a particular host, and any special host modes for the particular host adapter.

In other words, the cited section of Sicola merely restates that portion of the abstract quoted above, which clearly describes the access table used to control access by remote computers to LUNs within a disk array. This, in turn, corresponds to the access table described in the current application and referred to in Claims 1 and 6. It is unrelated the currently claimed supplemental access table, which, as Applicants' representative has carefully described above, controls access by CDLUNs within a disk array, essentially the disk-array controller itself, to LUNs within the disk array. Nothing in Sicola teaches, discloses, suggests, or even hints at controlling access by disk-array controllers, through CDLUNs, to LUNs within a disk array. In short, what the Examiner has pointed to as describing a supplemental access table in fact discloses and teaches an access table similar to that referred to in Claims 1 and 6, and in the current application, and not a supplemental access table.

In Section 15 of the Office Action, the Examiner additionally references the Schultz reference. The Schultz reference, just as the NT Server reference and the Tulloch reference, is directed to PC operating systems and distributed file systems, and has nothing at all to do with mass-storage devices and mass-storage-device controllers, such as disk arrays and disk-array controllers. Again, the Examiner appears to equate files controlled by assess lists within a file system to logical units controlled by access tables in a disk array. The analogy is not justified. File systems are not mass-storage devices. Instead, file systems are implemented by operating systems using primitive I/O calls directed to mass-storage devices.

In summary, of the four references cited by the Examiner, only the Sicola reference appears to be related to the current application. The Sicola reference

discloses a configuration-table-based method for controlling access by remote host computers to LUNs provided by a disk-array controller. The method disclosed by Sicola corresponds to the prior-art method described by Applicants in the Background of the Invention section of the current application. Sicola makes no mention, suggestion, or hint of CDLUNs and supplemental access tables that control access by CDLUNs to LUNs or, in other words, access by a disk-array controller to LUNs provided by the disk-array controller on behalf of requested remote host computers.

All of the claims remaining in the current application are clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited. The application is now clearly in order for allowance.

Respectfully submitted,
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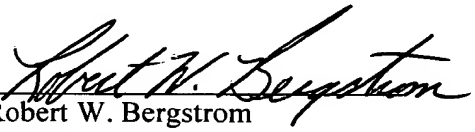

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